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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/042,475
Filing Date: January 09, 2002
Appellant(s): DAHLBERG, KENNETH E.

J. Paul Plummer
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 16 June 2006 appealing from the Office action mailed 18 January 2006.

(1) Real Party in Interest

A statement identifying by name the real part in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings, which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of the claimed invention as applied to claim 1 appears to read in limitations from the specification. Applicants refer to many portions of the specification to refer to features that are not required by the claim. For example, claim 1 recites "one of said parameters being aspect ratio." Although the claim recites aspect ratio it does not require it. The claim utilizes a set of parameters whereby one of the parameters is the aspect ratio. However, the aspect ratio is not required by the claim. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellants statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Index

The copy of the appealed claims contained in the Appendix to the brief are correct.

(8) Evidence Relied Upon

i) **Malinverno et al. "Uncertainty Constrained Subsurface Modeling", WO 00/48022**

ii) **Tabanou et al. "Method and Apparatus for Detecting and Quantifying Hydrocarbon Bearing Laminated Reservoirs on a Workstation", U.S. Patent No. 5,461,562**

iii) **University of Washington, *CRiSP1.6 Theory & Calibration Manual: VII.1 – Glossary***

(9) Grounds of Rejection

The following grounds of rejection are applicable to the appealed claims:

i) **Claims 1-6, 8, and 10-12 are rejected** under 35 U.S.C. 102(a) as being clearly anticipated by **Malinverno et al. "Uncertainty Constrained Subsurface Modeling", WO 00/48022,** hereafter referred to as **Malinverno,**

Regarding Claim 1:

Malinverno discloses a method of analyzing data obtained from well logs taken in a subsurface geological to determine an expected value of the hydrocarbon pore volume of the formation, comprising:

(a) defining an initial model of the subsurface formation based upon estimates of different bed types and bed-type parameters in the formation, one of said bed-type parameters being aspect ratio, the initial model including a system of log equations for predicting well logs from bed-type parameters; **(Page 1, Paragraph 3, Background of Invention. Page 2, Paragraph 1. Page 8, Paragraph 2)**

(b) performing a Monte Carlo inversion to find the ranges of bed-type parameters consistent with the measured well log data; **(Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line)**

(c) determining a statistical distribution for hydrocarbon pore volume representing the expected value for and an uncertainty in the hydrocarbon pore volume from said Monte Carlo inversion. **(Page 4, Paragraph 1, Lines 1-3. Page 4, Paragraph 2, Lines 1-6)**

Regarding Claim 2:

Malinverno discloses the method of claim 1 wherein at least one of said bed types has a finite lateral extent and a positive aspect ratio. **(Page 8, Paragraph 2)**

Regarding Claim 3:

Malinverno discloses The method of claim 1 wherein the step of defining the initial subsurface formation model comprises:

(a) selecting an analysis interval; **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line)**

(b) obtaining average values of the measured well log data over the analysis interval; **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

(c) formulating a set of reservoir and non-reservoir bed types constituting the selected analysis interval. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

(d) determining average values of the petrophysical parameters for each bed type. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

(e) assigning relative frequency of occurrence of the different bed types in the formation. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

(f) computing log responses for each bed type and over the composite analysis interval; **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

(g) comparing the computed log responses to the measured log data for consistency. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

(h) repeating steps (b) to (g) until the model parameters are consistent with the measured log data. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

Regarding Claim 4:

Malinverno discloses the method of claim 1 wherein the step of performing the Monte Carlo inversion comprises:

(a) estimating uncertainty ranges for each bed-type parameter and for bed frequencies. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

(b) generating a random model consisting of random variants for each bed-type parameter and frequency; **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

(c) computing estimates of average log responses over an analysis interval of the model; **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

(d) comparing the computed log responses to the measured log data for consistency. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

(e) retaining the model only if estimated log responses are consistent with measured log responses; **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

(f) repeating steps (a) to (e) until a specified number of trials has been completed. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

(g) computing distribution statistics for interval hydrocarbon pore volume and related parameters. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

Regarding Claim 5:

Malinverno discloses the method of claim 1 wherein the step of performing the Monte Carlo inversion includes estimating uncertainties for the formation bed properties and for the volume fractions. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Page 8, Paragraph 2)**

Regarding Claim 6:

Malinverno discloses the method claim 1 wherein the step of performing a Monte Carlo inversion is carried out using a programmed digital computer. **(Figure 2)**

Regarding Claim 8:

Malinverno discloses the method of claim 7 wherein the accuracy of the input parameters of the formation model are described in terms of probability distributions of parameter values and wherein the step of performing a Monte Carlo inversion involves making a plurality of cases wherein each case comprises a random selection of a parameter value for each input parameter from the probability distribution and calculating a set of outputs. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line)**

Regarding Claim 10:

Malinverno discloses the method of claim 9 wherein the step of performing a Monte Carlo inversion involves making at least one thousand cases and each resultant set of outputs comprises calculated log responses. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. This step would be inherent with respect to the prior art because an uncertainty is**

determined by measurements which in turn determine the number of models (cases) and thus includes any number of possible cases)

Regarding Claim 11:

Malinverno discloses 11. The method of claim 10 wherein the resultant set of outputs from each case is retained only if that case produces a set of calculated log response outputs which correspond to the input log values within a specified closeness of fit. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line. Calculating a response with a specified closeness of fit is inherent with the Monte Carlo Method)**

Regarding Claim 12:

Malinverno discloses the method of claim 11 further comprising the step of storing the retained sets of outputs and analyzing them for a determination of uncertainty in the estimate of hydrocarbon pore volume. **(Figures 1 & 2. Page 4, Paragraph 1, Last 2 Lines. Page 4, Paragraph 2, Last Line)**

ii) **Claim(s) 7 and 9 are** rejected under 35 U.S.C. 103(a) as being unpatentable over **Malinverno** in view of **Tabanou et al. "Method and Apparatus for Detecting and Quantifying Hydrocarbon Bearing Laminated Reservoirs on a Workstation", U.S. Patent No. 5,461,562,** hereafter referred to as **Tabanou.**

Regarding Claim 7:

Malinverno discloses The method of claim 1 wherein the formation model has inputs which comprise a set of parameters describing the thinly bedded formation and has outputs which are the formation average porosity, average water saturation, and average hydrocarbon pore volume.

Malinverno does not explicitly disclose the sand fraction.

However, **Tabanou,** refers to the output of sand fraction. **(Tabanou, Column 1, Lines 26-27. Column 2, Lines 37-38).**

It would therefore have been obvious to a person of ordinary skill in the art to derive the formation properties discussed in **Malinverno** as well as including the formation properties discussed in **Tabanou** in order to acknowledge the amount of sand that is inherently present in the formation.

Regarding Claim 9:

Malinverno does not explicitly disclose the method of claim 8 wherein the step of performing a Monte Carlo inversion is made using a spreadsheet programmed in a digital computer and wherein each case involves a recalculation of the spreadsheet to obtain a resultant set of outputs.

However, **Tabanou,** refers to the use of ELAN software, which utilizes spreadsheets with respect to volumetric analysis. **(Tabanou, Column 4, Lines 48-50).**

It would therefore have been obvious to a person of ordinary skill in the art to perform the Monte Carlo inversion as discussed in **Malinverno**, utilizing spreadsheet software discussed in **Tabanou** in order to allow for better organization of statistical data as well as ease of recalculation and display.

(10) Response to Argument

Response to Argument – Prior Art Rejections

Appellant's arguments pertaining to the 102 rejections are not persuasive. Appellant's arguments focusing on claims 1-3 are addressed in the order in which they are presented in the Appeal Brief starting on Page 4.

Considering all arguments the thrust of Appellants argument appears to revolve around the "aspect ratio" parameter and is shown in Figure 1 of the instant application in the second portion of the

Figure containing oblate ellipsoids. As per Paragraph 28 of the specification an aspect ratio of 0, representing parallel planar beds, reads on claim 1 based on the Malinverno references Figure 3 in view of Applicants definition. Although the claim recites aspect ratio it does not require it. The claim utilizes a set of parameters whereby one of the parameters may be the aspect ratio. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims.

(10.1) Appellant argues, on Page 4, Argument, Paragraph 1, that the Malinverno reference does not disclose or suggest any technique for dealing with aspect ratios, layers of finite lateral extent, as well as classifying all beds into bed types, each bed type characterized by bed-type parameters, with beds of finite lateral extent dealt with by including bed aspect ratio among the bed type parameters.

Examiners Answer:

The Malinverno reference discusses on page 8, paragraph 2 a "layered earth with material properties" which meets the definition of bed types, as defined in the specification. In addition, Appellant has not clarified how the reference does not disclose finite extent aspect ratios as opposed to an infinite extent aspect ratio. As per paragraph 29 of the specification of the instant application, an aspect ratio is defined to be "the ratio of bed thickness to bed width." The aspect ratio can range from 0 to 1. Although the Malinverno reference does not explicitly state the phrase "aspect ratio", based on the provided definition the layered earth discussed in the reference will inherently have as a parameter an aspect ratio and this ratio will fall somewhere in the range provided by the specification of the instant application.

See also Page 2, Paragraphs 1-2 regarding bed types and parameters as well as Page 8, Paragraph 2 **"The model of the subsurface area will typically have geometrical model parameters representing geological boundaries and material parameters..."** and **"The model of the subsurface area may be, for instance, a layered medium representing a layered earth with material properties that are constant or variable within each layer"** and **"may be a geometry-based model having material**

property values defined on a plurality of discrete geometrical sub-regions within the subsurface area."

See also Claims 1-3 and 7.

(10.2) Appellant further argues, on Page 5, 1st Line, that the Malinverno reference does not disclose or suggest averaging the measured data over the analysis interval before analyzing.

Examiners Answer:

However the reference discloses the use of Monte Carlo methods. A Monte Carlo method is defined as "a technique for producing estimates of "true" outcomes of stochastic processes by simply running many iterations of the model process and averaging the outcomes together. Results are given as statistics, eg mean and standard deviation of variable X," taken from the University of Washington, *CRiSP1.6 Theory & Calibration Manual: VII.1 – Glossary.* Following this definition, the Monte Carlo method discussed in the reference would utilize averaging in its calculations and would therefore read on the claim.

(10.3) Appellant further argues, on Page 5, Paragraph 1, that the Malinverno reference would require "enormous computing resources" in order to perform its functions in contrast with Appellants claimed invention.

Examiners Answer:

Since the Appellant has admitted that the claim limitations do not disclose the issue of computing resources this issue will not be addressed.

(10.4) Appellant further argues, on Page 5, Paragraph 3, with respect to Claim 1 that the Malinverno reference "needs to represent each layer explicitly in his model."

Examiners Answer:

The Examiner notes that the Appellant appears to be conceding that the reference can perform the function of the Appellants invention dependent upon the type of data provided for the calculations in the reference. However, the Malinverno reference also states in the Abstract and Brief Summary of Invention, First sentence a model is created representing a "subsurface area" which appears to be a representation as a whole and not necessarily as explicit layers.

(10.5) Appellant further argues, on Page 6, Paragraph 1, with respect to Claim 1 that the Malinverno reference does not disclose or suggest that the model can be "based upon estimates of bed types and bed-type parameters in the formation" or "that the layers should be classified into common bed types."

Examiners Answer:

The Malinverno reference discloses in the citations provided as well as on Page 9, Paragraphs 1-2, the model being established based on a basis of estimates of bed types and bed types parameters. Specifically, the reference discloses identifying inconsistencies in the measurement data consistent with parameters of the model.

With respect to the classification of the layers into common bed types, Claim 1 does not disclose this limitation as can be seen by Appellants direction to the Figures of the instant application rather than an actual claim limitation. However assuming, for the sake of argument, that the claim discloses this limitation, the references discussion of the material properties of layered earth would read on this limitation since different layers would have differing material properties, e.g. sandstone vs. shale, and would therefore be analyzed based on their respective characteristics. Therefore, differing layers with similar properties would be calculated in a common manner as opposed to differing layers.

(10.6) Appellant further argues, on Page 6, Paragraph 2, with respect to Claim 1 that the Malinverno reference teaches an explicit representation of subsurface layers rather than "defining an initial model of the subsurface formation" as discussed in Claim 1.

Examiners Answer:

As can be seen in the Abstract and Brief Summary of Invention, First sentence, of the Malinverno reference, a model is created representing a "subsurface area" which appears to correspond to a "subsurface formation."

(10.7) Appellant further argues, on Page 6, Paragraph 3, with respect to Claim 1 that the Malinverno reference does not disclose "aspect ratio" or its corresponding use in the claim.

Examiners Answer:

In addition to the arguments presented above in section (10.1) the Examiner notes that "aspect ratio" is discussed in the claim as merely "one of said bed type parameters." Although the claim recites aspect ratio it does not require it. The reference discloses bed types as well as properties as presented in section (10.1-6) above.

(10.8) Appellants arguments, on Page 7, Paragraph 1, with respect to Claim 1 are merely a restatement of the arguments provided in the previous sections specifically indicating that the Malinverno reference does not disclose bed types.

(10.9) Appellants arguments, on Page 7, Paragraph 2, with respect to Claim 3 are mainly that the reference does not disclose or suggest "averaging the measurement data over the analysis interval" in order to refine the model.

Examiners Answer:

The Monte Carlo method discussed in the Malinverno reference is used to update a model as can be seen on Page 4, Paragraph 1-2 of the reference. As stated in section (10.2) above the Monte Carlo method utilizes averaging in its calculation, therefore based upon available measurements as well as the Monte Carlo method performed in the reference the model is further updated. See Page 12, last paragraph regarding the well-known techniques of **"statistical and geophysical inversion."**

(10.10) Considering all arguments the thrust of Appellants argument appears to revolve around the "aspect ratio" parameter and is shown in Figure 1 of the instant application in the second portion of the Figure containing oblate ellipsoids. As per Paragraph 28 of the specification an aspect ratio of 0, representing parallel planar beds, reads on claim 1 based on the Malinverno references Figure 3 in view of Applicants definition. Although the claim recites aspect ratio it does not require it. The claim utilizes a set of parameters whereby one of the parameters may be the aspect ratio. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the Examiner in the Related Appeals and Interferences section of this Examiner's Answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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